

ORGANIC CHEM

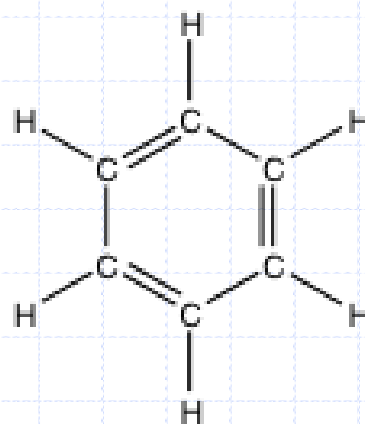
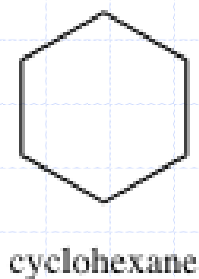
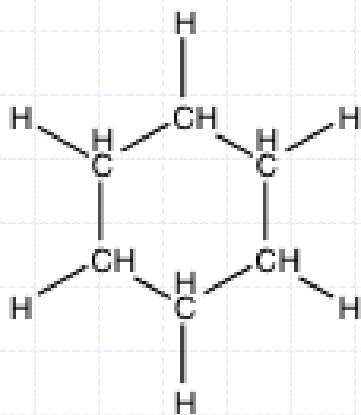
10.3.5 – 10.6

IB Chemistry
Topic 10 – Organic

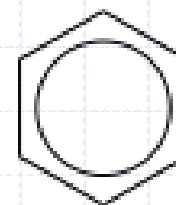


Arenes (aromatic compounds)

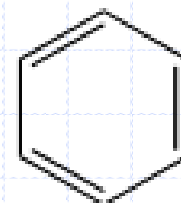
- ◆ The benzene ring has the formula C_6H_6
- ◆ Carbon atoms are arranged in a ring structure and can be represented in several different ways.



benzene



benzene



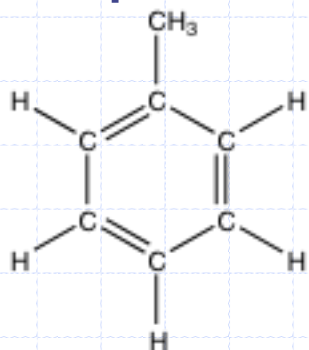
benzene



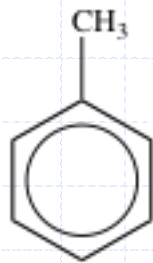
cyclohexane

Phenyl Group Compounds

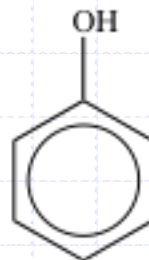
- ◆ Instead of R representing an alkyl group, it can also mean an aryl group.
- ◆ Aryl groups are based on benzene
 - $\text{-C}_6\text{H}_5$ or phenyl group
 - Can be attached to a wide range of functional groups



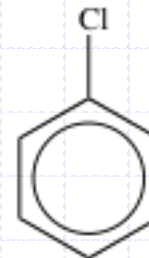
methylbenzene



methylbenzene



phenol



chlorobenzene



Economic Importance of Alkenes

- ◆ Alkenes readily undergo addition reactions and are used as starting materials for many important industrial chemicals.
- ◆ On the next slide you will find a flow chart for the production of compounds from ethene



Catalytic Cracking of ethene



10.4 Alcohols

- ◆ Contain the hydroxyl (-OH) group
- ◆ Formula $C_nH_{2n+1}OH$
- ◆ Polar group → increases solubility of compound
- ◆ Most common is ethanol, C_2H_5OH
- ◆ Can form hydrogen bonds with water through the hydroxyl group



Complete combustion of alcohol

- ◆ Exothermic, used as fuels
- ◆ Amount of energy released increases as you go up the homologous series

Combustion Equation	ΔH_c^θ	CO ₂ : alcohol ratio
$2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$	-726 kJ/mol	1:1
$2\text{C}_2\text{H}_5\text{OH} + 5\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}$	-1376 kJ/mol	2:1
$2\text{C}_5\text{H}_{11}\text{OH} + 15\text{O}_2 \rightarrow 10\text{CO}_2 + 12\text{H}_2\text{O}$	-3330 kJ/mol	5:1



Alcohol vs. Alkane

Equation	Molar production	Gram production
$2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$	-726 kJ/mol	29.8 kJ/g
$2\text{C}_8\text{H}_{18} + 25\text{O}_2 \rightarrow 16\text{CO}_2 + 18\text{H}_2\text{O}$	-5512 kJ/mol	48.4 kJ/g

◆ Ethanol vs. Octane comparison shows that one gram of octane produces 60% more energy than the same mass of ethanol.



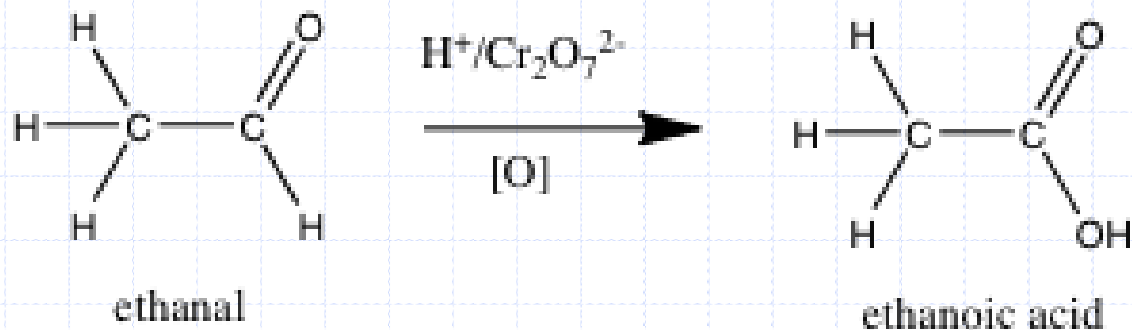
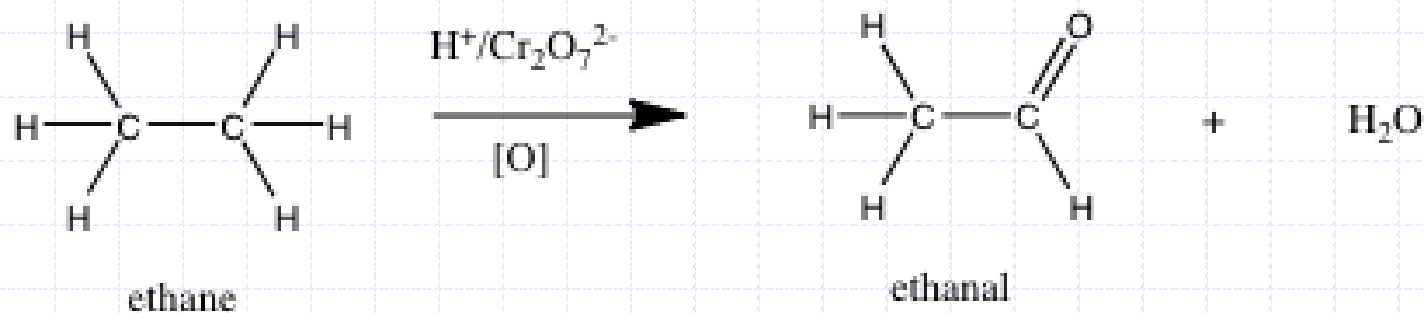
Oxidation Reactions of alcohols

- ◆ Alcohol functional group is capable of being oxidized
- ◆ Products depend on whether the alcohol is primary, secondary tertiary
- ◆ Common laboratory oxidizing agent is potassium dichromate (VI). This is a bright orange solution.
- ◆ When reaction mixture is heated a color change takes place as $\text{Cr(VI)} \rightarrow \text{Cr (III)}$ which is green. Alcohol is oxidized.



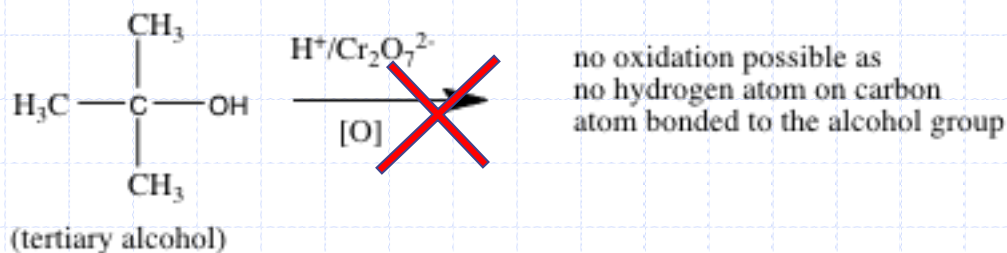
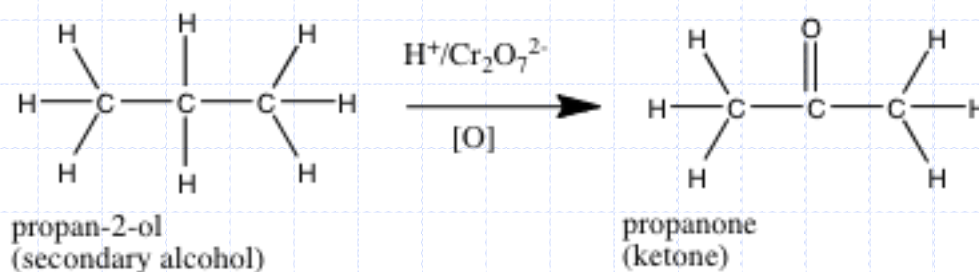
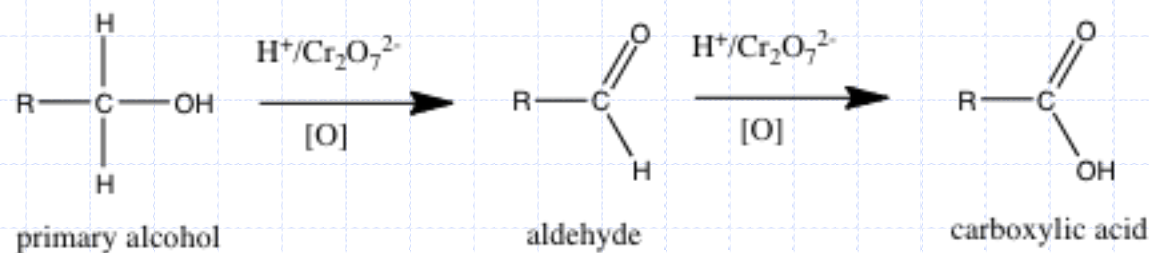
Primary alcohol oxidation

- Primary alcohols are oxidized in a two stage process, first to a aldehyde, then to a carboxylic acid



Primary, Secondary, Tertiary

- ◆ Primary, two steps
- ◆ Secondary, one step
- ◆ Tertiary, no steps!



10.5 Halogenalkanes

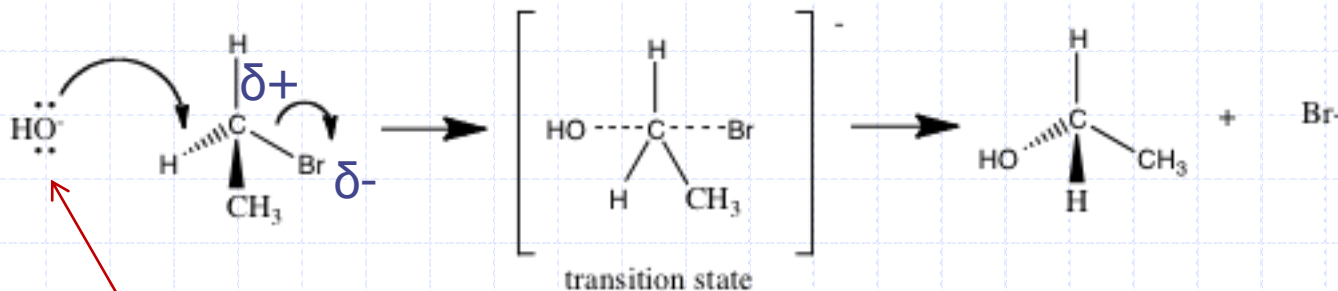
- ◆ Halogenalkanes contain an atom of fluorine, chlorine, bromine, or iodine bonded to the carbon skeleton of the molecule
- ◆ General formula $C_nH_{2n+1}X$, where X =halogen
- ◆ Generally oily liquids that do NOT mix with water
- ◆ Saturated compounds in which the halogen can be replaced by other atoms or groups in **substitution reactions.**



- ◆ Ex. CFC's common in aerosols, break down ozone layer

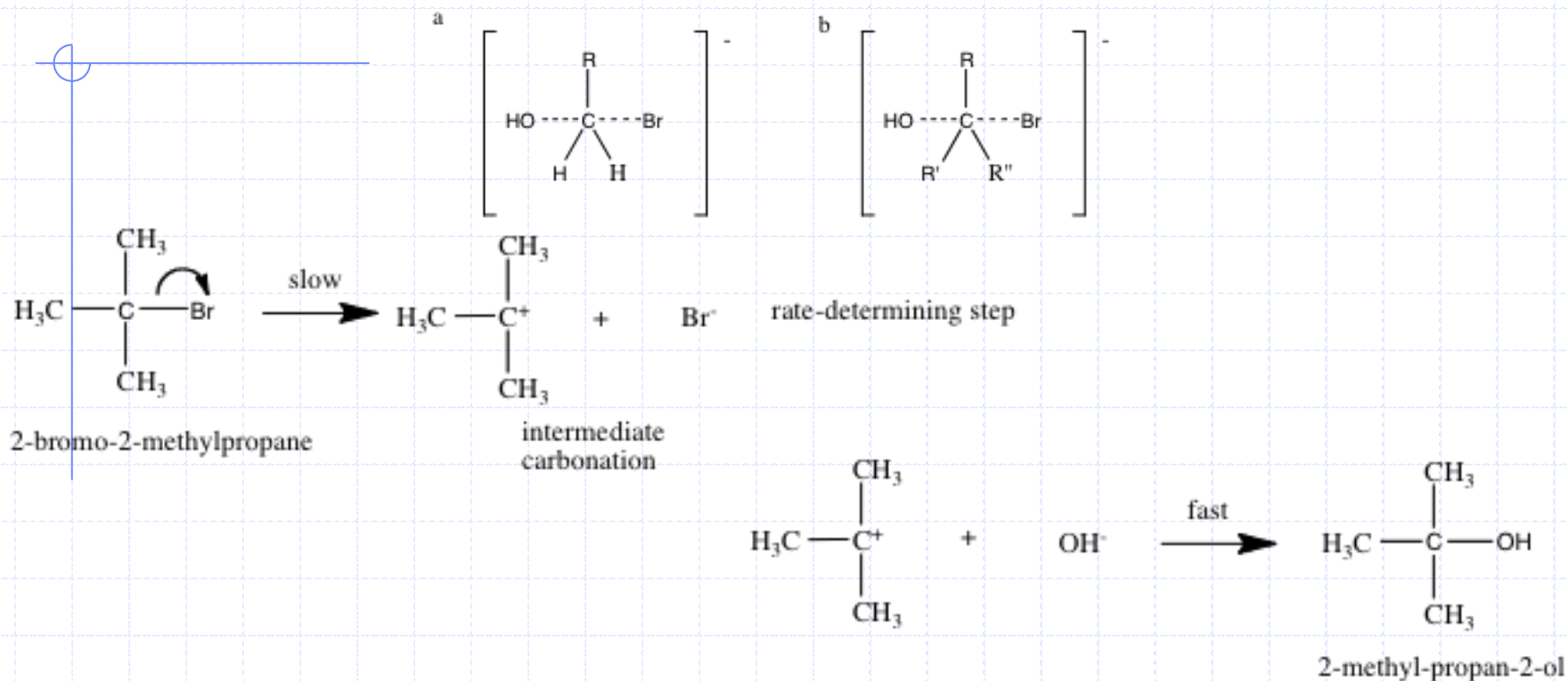
Secondary substitution....

- ◆ The greater the electronegativity of the halogen atom means that the carbon-halogen bond is polarized
- ◆ The carbon atom is then electron deficient making it susceptible to nucleophiles, like compounds containing -OH

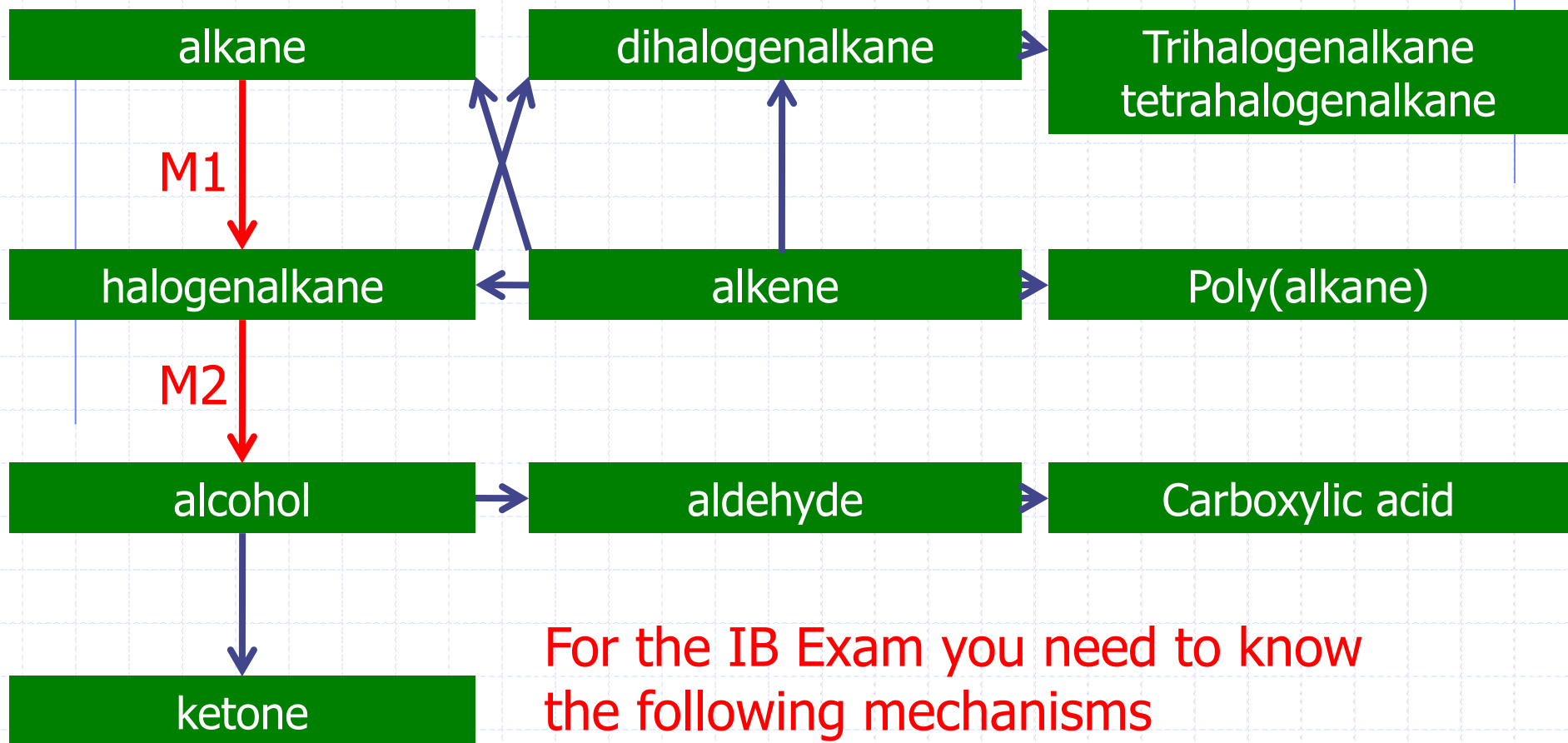


nucleophile

For primary or tertiary compounds



10.6 Reaction Pathways



For the IB Exam you need to know the following mechanisms

M1 – Halogen / UV light

M2 – NaOH

